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AUTHOR Hollenbeck, James Edward
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ABSTRACT

This paper makes a case for considering science as one of the humanities by describing the use of the Chautauqua Model in the state of Iowa to affect teacher attitude and behavior. The model includes a two-week experience with science, technology, and society teaching and learning (STS); a two-and-one-half day short course; planning and usage of a 20-day STS module; identification of local resources; and a follow-up short course. A discussion of the positive effects of STS instruction is also included. (DDR)

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Science, Technology and Society: an American Approach to Environmental Education in Practice in Iowa Schools

James Edward Hollenbeck
The University Of Iowa

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Science, Technology and Society; an American Approach to Environmental Education in Practice in Iowa Schools

James E. Hollenbeck

A quarter of a century ago, C.P. Snow coined a phrase that has become incorporated into modern speech in his Rede Lecture at Cambridge University. The phrase the "The Two Cultures", later became a title for Snow's book, a commentary on the scientific worldview and the literary, humanistic worldview tradition. I believe that Mr. Snow could have easily brought a third world in to view, the technical view of applications and mechanics. Like Snow, a novelist and physicist, I claim membership in all three worlds, (two in his case) because I am a science educator. I achieved a Bachelor's degree in History and General Science, nonetheless these three worlds are separated by mutual ignorance and misunderstanding. This division between the disciplines is ironic and unfortunate. The Latin word scienta simply means "Knowledge". What we call physics today was generally referred to as "natural philosophy" until the 19th century. "Human philosophy" or " the humanities" was reserved for those branches of learning that traditionally been concerned with the human condition, e.g.: literature, philosophy and history. (1) This is a shameful assumption, as science is concerned with the human condition. L. S. Kubie once went so far as to call science "the greatest of the humanities" because of the 'humility and honesty which it constantly corrects its own errors" (2). Science implores its inquirers to tease the evidence, examine the observable and test the validity of the outcome. Science must stand the test of fallibility. A bit dramatic, yet it does imply a definition of the humanities and science's claim to be among the humanities. I declare that science has much to say about what it is to be human and the role of humans in the cosmos.

American schools modeled after our European "roots" segregated the sciences, from the vocational-technical studies, and the technical-vocational studies from the humanities. Science, technology and society (STS) efforts got underway in the United States in the 1980's. Interest in STS was stirred in a National Science Teacher's Association position paper that proclaim: "The goal of science education during the 1980s is to develop scientifically literate

Individuals who understand how science, technology, and society influence on one another and who are able to use their knowledge in their every day decision making. The scientifically literate person has a substantial knowledge base of facts, concepts, conceptual networks, and process skills that enable the individual to continue and learn logically. This individual both appreciates the value of science and technology in society and understands their limitation"(3).

The state of Iowa, one of seventeen states, was the only state to focus on STS materials and strategies. A National School Chautauqua Program, supported by National Science Foundation (NSF) and National Science Teacher Association (NSTA) was established for an interim period. The Chautauqua Model was seen as one that could affect teacher attitude and behavior concerning exemplary teaching practice (4). The model included the following essential features:

1. A two week experience with STS teaching and learning that includes planning a five day STS module;
2. A two and one half-day short course, which includes other teachers from other schools of the summer participant workshop, conducted in the first part of the school year;
3. Planning and using a 20 day STS module with a pre-and post assessment program to evaluate student learning;
4. Identification of local resources (human and material) along with "pooling" of resources to bring in more distant resources by member schools;
5. A follow up short course some months later for sharing the results of the STS efforts with the other workshop participants.

The Iowa Chautauqua Program reached over 4000 teachers, and was active for over a ten-year period. The success of the Iowa Chautauqua Program included specific features that were shared by the schools.

- Student identification of issues with local, state, national and international interests and impact;

- The use of local resources (human and material) to locate information that can be used in the problem resolution;
- The active involvement of students in seeking information that can be applied to solve real world problems;
- Extension of learning going beyond the class period, the classroom and school;
- A focus upon the impact of science and technology on individual students;
- A view that science content is more than concepts which students master for the exam;
- An emphasis upon career awareness- especially for science and technical careers.
- An identification of ways that science and technology are likely to affect the future.
- Finally, realization between "true" science and "pseudoscience". (5)

Many of our colleagues present STS in the terms of major societal and global problems, considered to be "too big" for our elementary level educators. Actually, nothing can be farther from the truth. STS teaching is essential on providing our young learners the skills to identify and solve problems. Research conducted at the University of Iowa by Yager, Mackinna, and Blunk (6) has consistently confirmed that when science is approached in this method, meaningful, long-term learning had occurred and that the learners were confident in approaching new problems (7). Children must be encouraged to question, allowed to explain their hypothesis, and devise tests to determine the validity of their explanation. This approach does not follow the traditional classroom model, in which we present the information, expect the students to memorize the information, and then recite it to us, so we can determine if they learned. If we only expected from our students, the status quo, never to change the world, this would be acceptable teaching.

Teaching students in the STS method is natural and will encourage them to embrace science as an important and very applicable discipline. We use the STS method everyday. When we drive our automobile, we are constantly "computing" mentally. We are unconsciously aware of the dire consequences if we do not heed to braking in time when we approach a stop sign. It

takes a certain amount of force to bring our speeding automobile to a stop, in doing so we invoke Sir Isaac Newton's Laws of Motion. Violations of these laws have rather severe penalties on our personal budget. When we change our speeds, or vehicles, we depend on prior learning and our ability to apply what we have learned to solve our stop sign problem when it is necessary.

Another application of STS methodology applied by all of us from yet an earlier age, a skill we learned from our mothers, the identification of safe food, that is not spoiled, and is safe for our consumption. Knowing that spoil fruit has certain characteristics, I can identify spoiled fruit in Iowa, Morocco, or India, and enjoy a safe journey. Karl Popper refers to this ability to the "imaginative preconception". Scientists to have learned to look for certain clues in their work, as well as mechanics, engineers, medical professionals and even chefs. STS teaches a method: identify the problem, think through the problem proposing explanations, and test your explanations.

STS means teaching and learning in the context of human experience. This does not free the student from classroom instruction. The teacher acts in the instructional role as a facilitator of learning. The classrooms become centers of teaching and learning in the context of the human experience. Skills and knowledge that are learned are applied to current and future experiences when the students leave the classroom.

STS uses the Constructivist Learning Model (CLM) which requires certain teaching strategies. These include (6) (8):

- Allowing student thinking to drive a lesson or an entire unit;
- Shifting activities and content plans to fit student responses, interest and ideas;
- Encouraging student initiation of ideas, greater participation in student learning, displays of leadership, and autonomy in planning and doing;
- Encouraging students to expand and follow-up on their ideas;
- Using cooperative learning strategies that emphasize collaboration, respect for individuality, and the division of labor tactics;

- Encouraging adequate time for reflection and analysis; respecting and using all ideas that students generate.

When the CLM is used in conjunction with the STS method, the following statements will characterize science-teaching programs:

- The program will be largely local student and school-based because they are more effective than college-based or commercially produced programs;
- Teachers with the assistance of local experts will actively participate in planning as program objectives are developed;
- Self-instruction by the students will be often evident;
- Individualized instruction will be seen as more effective than is age-group instruction, learning at that student's level, rather than another's level.
- Teachers will have an active role as opposed to a passive role in all aspects of the program.
- Students, teachers, and leaders will share and provide mutual assistance;
- Programs will be directly linked to the general effort of the school, therefore enhancing the curriculum to the community. Community support of their schools is always vital and this program brings the community into the school.

STS means dynamic teaching and learning. Many communities in Iowa have taken STS into their classrooms. I have personally used STS in teaching secondary science. One STS unit that I commonly share with my colleagues is on that dealt in developing a unit in microclimates. I began the unit by posing a question to the class for "brainstorming". Brainstorming is a cooperative technique used to collect as many questions on a topic that can be generated by the students, without stopping to evaluate each one. Of course, the topic must be clearly stated with some boundaries. One member of the group will act as a recorder, responsible for writing all the responses on a chalkboard during this session. One rule that all students must adhere to is all ideas are acceptable, and no idea is to be criticized. Creativity will be evident during this process.

Some of the questions posed by the students were:

- What is the difference between weather and climate?
- How do climates work?
- Do climates ever change?
- How you know you have a microclimate?
- How many microclimates do we have on the campus, in town, in the county?
- Can we make a microclimate?
- Are microclimates important in agriculture?
- Can microclimates change the weather?
- Did the climates kill the dinosaurs?

As one can gather from the scope of these, a few questions were wide in scope and interestingly enough, many, a textbook would pose, too. Textbooks do make wonderful resources and bases to start student inquiry. The difference between the textbook science method and the STS approach is that the students are asking the questions, and they are beginning to establish ownership of their learning. The next step of this process is looking for information, and presenting it to the their peers. The teacher is involved in this process, acting as the facilitator of information and coordinates the students so all the pieces begin to "fit together". Your role as a teacher becomes even more dynamic, and you are a learner with your students. I actually work harder, but I am able to apply my degree to work.

My students began their investigation with researching the topics on climates, what are the factors that determine climates: vegetation, geology, human intervention, meteorological and topography. During this time, the students begin to bring into class other related topics including deforestation, urbanization, industrialization, greenhouse gases, and agricultural practices. The students learned that it was the invention of the steam engine that fueled the Industrial Revolution, with coal, the global temperature had began a steady, yet slow increase. The invention and popular use of internal combustion engines coincident with a more rapid increase in global temperature increase. They had learned so much more than they would have in their textbooks. In addition, my students contacted meteorologists, and other professionals in

climatology to expand on their learning. The culminating project is a group assignment, The students were to take an assigned plot of land (one square meter) and alter the climate. They were to note the changes, vegetative analysis is most frequently chosen by the students. The students would conduct a preliminary analysis of their square meter, then modify the plot and take notes for a three-week period. At the end of the three-week period, they conduct another vegetative analysis, for a comparison. The assessment during this time is based on their performance on short assignments, their journal of class activities, and their square meter plot, which is presented as a "scientific paper" and poster paper which open to the public.

As an instructor, I was able to assess quickly if the student had learned about microclimates and global climates, or just memorized data. The report was reflective of what they had learned, how human activity can change the environment in small ways that can lead to large scale modifications that will impact their lives and others.

Students learn science by doing science. James Rutherford and Andrew Ahlgreen, authors of Science For All Americans, state that "The world has changed in such a way that scientific literacy has become necessary for everyone, not just a privileged few; science education will have to change to make that possible". (9) Science has entered the realm of the human experience that has not been matched since the discovery of the New World that unleashed the forces of the renaissance. Science knows neither boundaries nor ages. Science serves all, and like the descendents of Prometheus, we are charged with the awesome responsibility of charting the moral fiber for a world we will not see, but our children will shape. It is my hope that our new age truly ushers in a sharing of knowledge that will benefit all. STS can lead us in teaching responsibility with our applications of scientific knowledge. Carl Sagan, in his work Cosmos, which brought so many to science in the 1980s closes with this thought, I wish to share. "Our loyalties are to the species and the planet. We speak for the future of Earth." (10) We are touching the future.

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